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Contributions to the Mesozoic flora of the Atlantic coastal plain—
IX. Alabama*

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The Tuscaloosa formation as developed in western Alabama has been known for over fifty years to contain remains of fossil plants, and that it contained a large and varied Cretaceous flora has been known since Dr. Eugene A. Smith published a brief list of species in 1894. The principal items in the history of the study of this formation and its flora may be briefly enumerated as follows:

The Tuscaloosa formation was named by Smith and Johnson in 1887 (U. S. Geol. Surv. Bull. 43: 95) from the city and river (now usually known as the Warrior or Black Warrior River) of that name in Alabama. Earlier observers had noticed the presence of sands and clays below the recognized Cretaceous and above the Carboniferous, Professor L. Harper, the state geologist of Mississippi, mentioning them in print as early as 1856 (Proc. Acad. Nat. Sci. Phila. 8: 126-128) and suggesting that their age is perhaps Permian or possibly Triassic. The same year Prof. Alex. Winchell mentioned the Tuscaloosa mottled clays, calling attention to the contained vegetable remains "appearing like the stems and leaves of dicotyledonous plants." He doubted their Triassic age and in his table of formations they appear in the Lower Cretaceous (Proc. Am. Asso. Adv. Sci. 10²: 92. 1856). Meek and Hayden in discussing (Proc. Acad. Nat. Sci. Phila. 9: 117-133. 1857) the Alabama Mesozoic mentioned wood and leaves and correlated the lower part with the lowest Cretaceous of New Jersey and Nebraska. Their lithologic characterization clearly indicates that they are discussing the Tuscaloosa, and they say that although the weight of the evidence favors the correlating

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of these beds with the Neocomian of the Old World positive evidence is lacking that a part may not be older than Cretaceous. Subsequently, Professor Hilgard (Geol. and Agr. Miss. 61. 1860) described the beds in Mississippi beneath his Tombigbee sands as the Eutaw group and referred them to the Cretaceous. The following year Meek and Hayden restated their views and definitely correlated the beds in Alabama with the Dakota of the Western Interior (Proc. Acad. Nat. Sci. Phila. 13: 419-421. 1861).

Again in 1876 Meek (U. S. Geol. Surv. Terr. 9: 38-42) reaffirms his belief that the basal Cretaceous of Alabama is of the same age as the plastic clays of New Jersey and the Dakota sandstone of the Upper Missouri section.

All of these geologists failed to discriminate the Tuscaloosa from the overlying sands and laminated clays of what is now known as the Eutaw formation. The first reasonably complete account of the Tuscaloosa formation is given by Smith and Johnson in the publication previously alluded to. From the attitude, lithologic character, and stratigraphic position of the beds they correlated the Tuscaloosa with the Potomac of the Middle Atlantic slope, which had just been named and briefly described by McGee (Rep. Health Officer Dist. of Columbia for the year ending June 30, 1885: 19-21, 23-35), a natural correlation since the Potomac as understood in the earlier days of its study included beds which according to the opinions of different students were referred to various levels ranging from the Triassic to the Cretaceous and which subsequent study has shown to constitute a series of well-marked formations, the oldest of Neocomian age and the youngest of Cenomanian age.

From the year 1883 down to the present Dr. Eugene A. Smith, the distinguished state geologist of Alabama, has added to our knowledge of these deposits, being assisted in the earlier years by L. C. Johnson and D. W. Langdon, Jr. The discovery of all of the noteworthy localities for fossil plants is due to their efforts. In 1884 some leaf impressions collected by Langdon in Bibb County were submitted to Leo Lesquereux, among which he recognized a species of *Podozamites* which he thought might indicate a pre-Cretaceous age. Lesquereux afterward determined

a small collection of leaves from the Tuscaloosa beds at Tuscaloosa but this list seems never to have been published.

In 1886 Smith and Langdon discovered several localities for fossil plants in the vicinity of Tuscaloosa (Cottondale, Snows Place, Tuscaloosa) and the next year the United States Geological Survey sent Professor Fontaine into the field.

The latter made large collections of mostly fragmentary material from these outcrops as well as from one or two other outcrops near the town of Tuscaloosa. In 1892 Professor Lester F. Ward visited Alabama and in company with Dr. Smith made extensive collections from Glen Allen and Shirleys Mill. These collections received a preliminary study by Professor Ward, who furnished a list of 35 species which was published by Smith in 1894 in his Report on the Geology of the Coastal Plain of Alabama. This list enumerated the following forms:

<i>Andromeda latifolia</i> Newb. = <i>Andromeda</i>	<i>Ficus Woolsoni</i> Newb.
<i>grandifolia</i> Berry	<i>Liriodendropsis angustifolia</i> Newb.
<i>Andromeda novae-calcareae</i> Hollick (No-	<i>Liriodendropsis simplex</i> Newb.
<i>vae-Caesareae</i>)	<i>Magnolia alternans</i> Heer*
<i>Andromeda Parlatorii</i> Heer	<i>Magnolia auriculata</i> Newb.
<i>Aralia Wellingtoniana</i> Lesq. = <i>Aralia</i>	<i>Magnolia glaucoides</i> Newb. = <i>Magnolia</i>
<i>cottondalensis</i> Berry	<i>Boulayana</i> Lesq.
<i>Carpolithus floribundus</i> Newb.	<i>Magnolia longifolia</i> Newb. = <i>Magnolia</i>
<i>Celastrorphyllum crenatum</i> Heer	<i>Newberryi</i> Berry
<i>Celastrorphyllum undulatum</i> Newb.	<i>Magnolia speciosa</i> Heer
<i>Cinnamomum intermedium</i> Newb. = <i>Cin-</i>	<i>Myrsine borealis</i> Heer
<i>namomum Newberryi</i> Berry	<i>Populus apiculata</i> Newb. = <i>Cordia apicu-</i>
<i>Cladophlebis parva</i> Font. = <i>Cladophlebis</i>	<i>lata</i> Berry
<i>alabamensis</i> Berry	<i>Proteoides daphnogenoides</i> Heer = <i>Ficus</i>
<i>Cycadinocarpus circularis</i> Newb.	<i>daphnogenoides</i> Berry
<i>Czekanowskia capillaris</i> Newb.*	<i>Pterospermiles modestus</i> Lesq.*
<i>Dewalquea groenlandica</i> Heer*	<i>Tricalycites papyraceus</i> Newb.
<i>Diospyros primaeva</i> Heer	<i>Widdringtonites Reichii</i> (Ett.) Heer
<i>Eucalyptus attenuata</i> Newb.*	<i>Sequoia gracillima</i> (Lesq.) Newb. = <i>Wid-</i>
<i>Eucalyptus nervosa</i> Newb.*	<i>dringtonites Reichii</i> (Ettings.) Heer
<i>Eucalyptus parvifolia</i> Newb.*	<i>Sequoia heterophylla</i> Velenovsky
<i>Ficus inaequalis</i> Lesq.	<i>Sequoia Reichenbachii</i> (Gein.) Heer
<i>Ficus lanceolato-acuminata</i> Newb.*	

In preparation for my work I spent the field season of 1909 in Alabama, revisiting all of the known plant localities and making extensive collections. In company with Dr. L. W. Stephenson the Warrior and Tombigbee river sections were studied by means

* Not recognized by me.

of a launch trip from Tuscaloosa down to the Eocene contact at Moscow; the Coosa and Alabama rivers were traversed from Wetumpka to Montgomery; the Chattahoochee River from Columbus to Gainesville; the upper Tombigbee River in Mississippi and various localities in Tishomingo, Prentiss, and Itawamba counties, Mississippi, were explored. I have also had the benefit of the collections and notes made by Dr. L. W. Stephenson in his extensive field and office studies on the stratigraphy and paleozoology of the Cretaceous of the Eastern Gulf area, as well as the extensive collections previously made for the United States Geological Survey by Smith, Fontaine, and Ward. All of the types and duplicate material are in the collections of the United States National Museum.

Recognizable fossil plants have been found at the following localities in Alabama and a single locality in northeastern Mississippi: near Iuka, Mississippi; Glen Allen, Shirleys Mill, Tuscaloosa, Cottondale, Snow Place, Sanders Ferry Bluff, Whites Bluff, and several other localities in Alabama where only one or two species have been found. The identifiable species other than those new to science are enumerated in the following notes.

LOCALITY NEAR IUKA, MISSISSIPPI

This is the most northerly known plant-bearing outcrop of the Tuscaloosa formation. It is situated in a cut on the Southern Railway $1\frac{5}{8}$ miles east of Iuka in Tishomingo County, and while near the base of the formation in this county it is younger than the plant-bearing Tuscaloosa localities in Alabama.

The following species associated with water worn pellets of amber occur at this outcrop: *Andromeda Wardiana* Lesq., *Androvetia carolinensis* Berry, *Sequoia Reichenbachii* (Gein.) Heer.

LOCALITY NEAR GLEN ALLEN, ALABAMA

This outcrop is in a cut of the St. Louis and San Francisco R. R. about one-quarter of a mile east of Glen Allen near the northern boundary of Fayette County. The following species occur here:

Andromeda grandifolia Berry
Andromeda Novae-Caesareae Hollick
Andromeda Parlatorii Heer

Bauhinia marylandica Berry
Cinnamomum Newberryi Berry
Cissites formosus Heer

<i>Cornophyllum vetustum</i> Newb.	<i>Magnolia Newberryi</i> Berry
<i>Cycadinocarpus circularis</i> Newb.	<i>Magnolia speciosa</i> Heer
<i>Diospyros primaeva</i> Heer	<i>Marattia cretacea</i> Velenovsky (?)
<i>Diospyros rotundifolia</i> Lesq.	<i>Myrsine borealis</i> Heer
<i>Ficus daphnogenoides</i> (Heer) Berry	<i>Myrsine Gaudini</i> (Lesq.) Berry
<i>Ficus Krausiana</i> Heer	<i>Pterospermiles carolinensis</i> Berry
<i>Ficus Woolsoni</i> Newb.	<i>Salix Lesquereuxii</i> Berry
<i>Ilex Masoni</i> Lesq.	<i>Tricalycites papyraceus</i> Newb.
<i>Liriodendropsis simplex</i> Newb.	<i>Widdringtonites Reichii</i> (Ettings.) Heer
<i>Lycopodium cretaceum</i> Berry	<i>Zizyphus lamarensis</i> Berry
<i>Magnolia Lacoana</i> Lesq.	

LOCALITY AT SHIRLEYS MILL, ALABAMA

This outcrop is about twenty-five miles south of Glen Allen in southern Fayette County at a point where the old Fayette-Tuscaloosa coach road descends to the Davis Creek bottom. The following species occur at this locality:

<i>Acerates amboyensis</i> Berry	<i>Juglans arctica</i> Heer
<i>Andromeda grandifolia</i> Berry	<i>Kalmia Brittoniana</i> Hollick
<i>Andromeda Novae-Caesareae</i> Hollick	<i>Laurophyllum nervillosum</i> Hollick
<i>Andromeda Parlatorii</i> Heer	<i>Laurus plutonia</i> Heer
<i>Andromeda Wardiana</i> Lesq.	<i>Leguminosites omphaloboides</i> Lesq.
<i>Asplenium Dicksonianum</i> Heer	<i>Liriodendropsis angustifolia</i> Newb.
<i>Bauhinia cretacea</i> Newb.	<i>Liriodendropsis constricta</i> Ward
<i>Bauhinia marylandica</i> Berry	<i>Liriodendropsis simplex</i> Newb.
<i>Brachyphyllum macrocarpum</i> formosum	<i>Lycopodium cretaceum</i> Berry
Berry	<i>Magnolia Boulayana</i> Lesq.
<i>Carpolithus floribundus</i> Newb.	<i>Magnolia Hollicki</i> Berry
<i>Celastrorphyllum Brittonianum</i> Hollick	<i>Magnolia Lacoana</i> Lesq.
<i>Celastrorphyllum decurrens</i> Lesq.	<i>Magnolia longipes</i> Newb.
<i>Celastrorphyllum grandifolium</i> Newb.	<i>Magnolia obtusata</i> Heer
<i>Celastrorphyllum Newberryanum</i> Hollick	<i>Magnolia speciosa</i> Heer
<i>Cinnamomum Newberryi</i> Berry	<i>Malapoenna falcifolia</i> (Lesq.) Knowlton
<i>Citrophyllum aligerum</i> (Lesq.) Berry	<i>Myrica emarginata</i> Heer
<i>Colutea obovata</i> Berry	<i>Myrsine borealis</i> Heer
<i>Crotonophyllum panduraeformis</i> Berry	<i>Nyssa Snowiana</i> Lesq.
<i>Dammara borealis</i> Heer	<i>Palaeocassia laurinea</i> Lesq.
<i>Dermatophyllites acutus</i> Heer	<i>Panax cretacea</i> Heer
<i>Dequalquea Smithi</i> Berry	<i>Persoonia Lesquereuxii</i> Knowlton
<i>Dicksonia groenlandica</i> Heer	<i>Phaseolites formus</i> Lesq.
<i>Diospyros amboyensis</i> Berry	<i>Protodammara speciosa</i> Hollick & Jeffrey
<i>Diospyros primaeva</i> Heer	<i>Pterospermiles carolinensis</i> Berry
<i>Diospyros rotundifolia</i> Lesq.	<i>Rhamnus tenax</i> Lesq.
<i>Ficus daphnogenoides</i> (Heer) Berry	<i>Salix flexuosa</i> Newb.
<i>Ficus inaequalis</i> Lesq.	<i>Salix Lesquereuxii</i> Berry
<i>Ficus Krausiana</i> Heer	<i>Salix Meekii</i> Newb.
<i>Ficus Woolsoni</i> Newb.	<i>Sequoia heterophylla</i> Velenovsky
<i>Geinitzia formosa</i> Heer	<i>Tricalycites papyraceus</i> Newb.
<i>Gleichenia delicatula</i> Heer	<i>Widdringtonites Reichii</i> (Ettings.) Heer
<i>Inga cretacea</i> Lesq.	<i>Widdringtonites subtilis</i> Heer

LOCALITIES NEAR TUSCALOOSA

The following list embraces species occurring at several outcrops in and near the town of Tuscaloosa in Tuscaloosa County:

<i>Andromeda grandifolia</i> Berry	<i>Ficus Woolsoni</i> Newb.
<i>Andromeda Parlatorii</i> Heer	<i>Magnolia speciosa</i> Heer
<i>Diospyros primaeva</i> Heer	<i>Salix flexuosa</i> Newb.
<i>Ficus daphnogenoides</i> (Heer) Berry	<i>Salix Lesquereuxii</i> Berry

LOCALITY NEAR COTTONDALE

This locality is along the public road about 10 miles east of Tuscaloosa and two miles southeast of the town of Cottondale in Tuscaloosa County. The following species have been identified from this outcrop:

<i>Andromeda Parlatorii</i> Heer	<i>Liriodendron Meekii</i> Heer
<i>Bauhinia cretacea</i> Newb.	<i>Magnolia Capellinii</i> Heer
<i>Bauhinia marylandica</i> Berry	<i>Magnolia longipes</i> Newb.
<i>Celastrorhynchium crenatum</i> Heer	<i>Magnolia speciosa</i> Heer
<i>Celastrorhynchium grandifolium</i> Newb.	<i>Malapoenna cretacea</i> (Lesq.) Knowlton
<i>Celastrorhynchium undulatum</i> Newb.	<i>Myrica emarginata</i> Heer
<i>Cinnamomum Newberryi</i> Berry	<i>Myrsine Gaudini</i> (Lesq.) Berry
<i>Citrorhynchium aligerum</i> (Lesq.) Berry	<i>Persea valida</i> Hollick
<i>Cocculus cinnamomeus</i> Velenovsky (?)	<i>Phaseolites formosus</i> Lesq.
<i>Diospyros primaeva</i> Heer	<i>Pinus raritanensis</i> Berry
<i>Ficus daphnogenoides</i> (Heer) Berry	<i>Platanus latior</i> (Lesq.) Knowlton
<i>Ficus inaequalis</i> Lesq.	<i>Populus hyperborea</i> Heer
<i>Ficus Krausiana</i> Heer	<i>Protophyllocladus subintegrifolius</i> (Lesq.)
<i>Ficus Woolsoni</i> Newb.	Berry
<i>Geinitzia formosa</i> Heer	<i>Pterispermiles carolinensis</i> Berry
<i>Ilex Masoni</i> Lesq.	<i>Salix Lesquereuxii</i> Berry
<i>Juglans arctica</i> Heer	<i>Sassafras acutilobum</i> Lesq.
<i>Laurus plutonia</i> Heer	<i>Sequoia Reichenbachii</i> (Gein.) Heer

LOCALITY ON SNOW PLANTATION

Two plant-bearing outcrops occur on the Snow Plantation about nine miles southwest of Tuscaloosa. These are known in the literature as "Upper Ravine" and "Big Gully, Snow Place" and are in enormous gullies eroded into the upland from the west bank of the Warrior River. The following species occur here:

<i>Abietes foliosus</i> (Font.) Berry	<i>Dammara borealis</i> Heer
<i>Andromeda grandifolia</i> Berry	<i>Dicksonia groenlandica</i> Heer
<i>Andromeda Novae-Caesareae</i> Hollick	<i>Dryopterites Stephensoni</i> Berry
<i>Andromeda Parlatorii</i> Heer	<i>Eucalyptus Geinitzi</i> Heer
<i>Celastrorhynchium carolinense</i> Berry	<i>Eucalyptus latifolia</i> Hollick
<i>Celastrorhynchium crenatum</i> Heer	<i>Ficus crassipes</i> Heer

<i>Ficus daphnogenoides</i> (Heer) Berry	<i>Salix Lesquereuxii</i> Berry
<i>Ficus Krausiana</i> Heer	<i>Sequoia ambigua</i> Heer
<i>Laurophyllum angustifolium</i> Newb. (?)	<i>Sequoia fastigiata</i> (Sternb.) Heer
<i>Myrica emarginata</i> Heer	<i>Sequoia Reichenbachii</i> (Gein.) Heer
<i>Myrsine borealis</i> Heer	<i>Tricalycites papyraceus</i> Newb.
<i>Podozamites marginatus</i> Heer	<i>Widdringtonites Reichii</i> (Ettings.) Heer
<i>Salix flexuosa</i> Newb.	<i>Widdringtonites subtilis</i> Heer

SANDERS FERRY BLUFF

This locality is on the west bank of the Warrior River about eleven miles southwest of Tuscaloosa in the county of that name. The following plants occur at this outcrop:

<i>Acerates amboyensis</i> Berry	<i>Salix flexuosa</i> Newb.
<i>Ficus crassipes</i> Heer	<i>Salix Lesquereuxii</i> Berry
<i>Ficus Krausiana</i> Heer	

WHITES BLUFF OUTCROP

This locality is on the right bank of the Warrior River in northeastern Green County, three hundred and nine miles above Mobile and near the top of the Tuscaloosa formation. The following species have been identified from this outcrop:

<i>Brachyphyllum macrocarpum</i> formosum	<i>Sequoia heterophylla</i> Velenovsky
Berry	<i>Sequoia Reichenbachii</i> (Gein.) Heer
<i>Dewalquea Smithii</i> Berry	<i>Widdringtonites Reichii</i> (Ettings.) Heer

In addition to the well-known Cretaceous species in the foregoing lists the Tuscaloosa formation has yielded upwards of fifty new species which are described in the following genera: *Aralia*, *Calycites*, *Capparites* (2), *Carpolithus*, *Cassia*, *Celastrorhynchium* (5), *Cladophlebis*, *Cocculus* (2), *Conocarpites*, *Eorhamnidium*, *Equisetum*, *Eugenia*, *Ficus* (3), *Grewiopsis* (2), *Hymenaea*, *Jungermannites*, *Leguminosites* (3), *Lycopodites*, *Malapoenna*, *Menispermites* (2), *Myrica*, *Oreodaphne*, *Persoonia*, *Phyllites* (2), *Piperites*, *Platanus* (2), *Populites*, *Proteoides*, *Sapindus*, *Sapotacites* (3), and *Sphaerites*.

The flora as a whole comprises over 150 species, of which over 40 per cent. of the genera are not represented in the existing flora. None of the species survive into the lower Eocene.

Eighty-seven genera segregated into 48 families in 31 orders are represented, the most abundant orders being the Ranales with 15 species, the Coniferales with 14 and the Urticales with 8. The largest single genus is *Celastrorhynchium* with 12 species. The

Dicotyledonae of the Tuscaloosa formation number 123 species, distributed in 34 families in 21 orders. The Choripetalae number 107, the Gamopetalae but 16 forms.

The flora as a whole is a lowland coastal flora, many of the species being strand types. It indicates a land surface of rather uniform topography, an abundant and well-distributed rainfall, equable temperatures of warm temperate or subtropical type, with slight seasonal changes.

Meager floras are found also in the younger Cretaceous strata of the Eutaw and Ripley formations, but these are not included in the present contribution.

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